On the Developement of Exponential Functions; together with several new Theorems relating to finite Differences. *By* John Frederick W. Herschel, *Esq. F.R.S.* Read December 14, 1815. [*Phil. Trans.* 1816, *p.* 25.]

The subject here considered by Mr. Herschel relates to the celebrated theorems of Lagrange, expressing the connection between simple exponential indices and those of differentiation and of integration.

Since the theorems have been demonstrated by various subsequent analysts, as by Laplace, by Arbogast, and by Dr. Brinkley, the author takes them for granted; but observes that in their original form they are but abridged expressions of their meaning; and that in order to become practically useful, their exponential functions require further development.

And though this part of the subject has been treated with great ability by Dr. Brinkley, who has deduced formulæ respecting the first of the two theorems far more simple than could have been expected from the complex nature of the subject; yet since his method, when applied to the second more general theorem, would lead to details of extreme complexity, Mr. Herschel has taken a different view of the subject; and beginning with the more general theorem has arrived at a general formula, which he believes to have been hitherto wholly unnoticed, and which, when applied to certain particular cases treated of by Dr. Brinkley, affords precisely the same results.

But the mode in which this subject is treated, or even the results, were not of a nature to admit of being read in public.

On new Properties of Heat, as exhibited in its Propagation along Plates of Glass. *By* David Brewster, *LL.D. F.R.S. Lond. and Edinb. In a Letter addressed to the Right Hon. Sir* Joseph Banks, *Bart. G.C.B. P.R.S.* Read January 11, 1816. [*Phil. Trans.* 1816, *p.* 46.]

In a paper communicated to the Society in May 1814, Dr. Brewster observed that glass, when raised to a high temperature, had the property of depolarizing light, and in this respect resembled crystallized substances; but he did not at that time succeed in tracing a resemblance in other points, which he left for future investigation.

On resuming this inquiry in the present paper, the subject is divided into two parts; in the former of which he describes the transient effects exhibited during the propagation of heat along plates of glass, whether received from adjacent bodies or communicated to them; and in the latter he describes the permanent optical properties produced in glass by being suddenly and partially cooled when red hot.

The phenomena here noticed depend on the total or partial depolarization of light, previously polarized by reflection at a certain angle from a surface of black glass. It is well known that when a ray of light thus polarized in the plane of primitive incidence is incident upon a second surface of black glass at the same specific angle,